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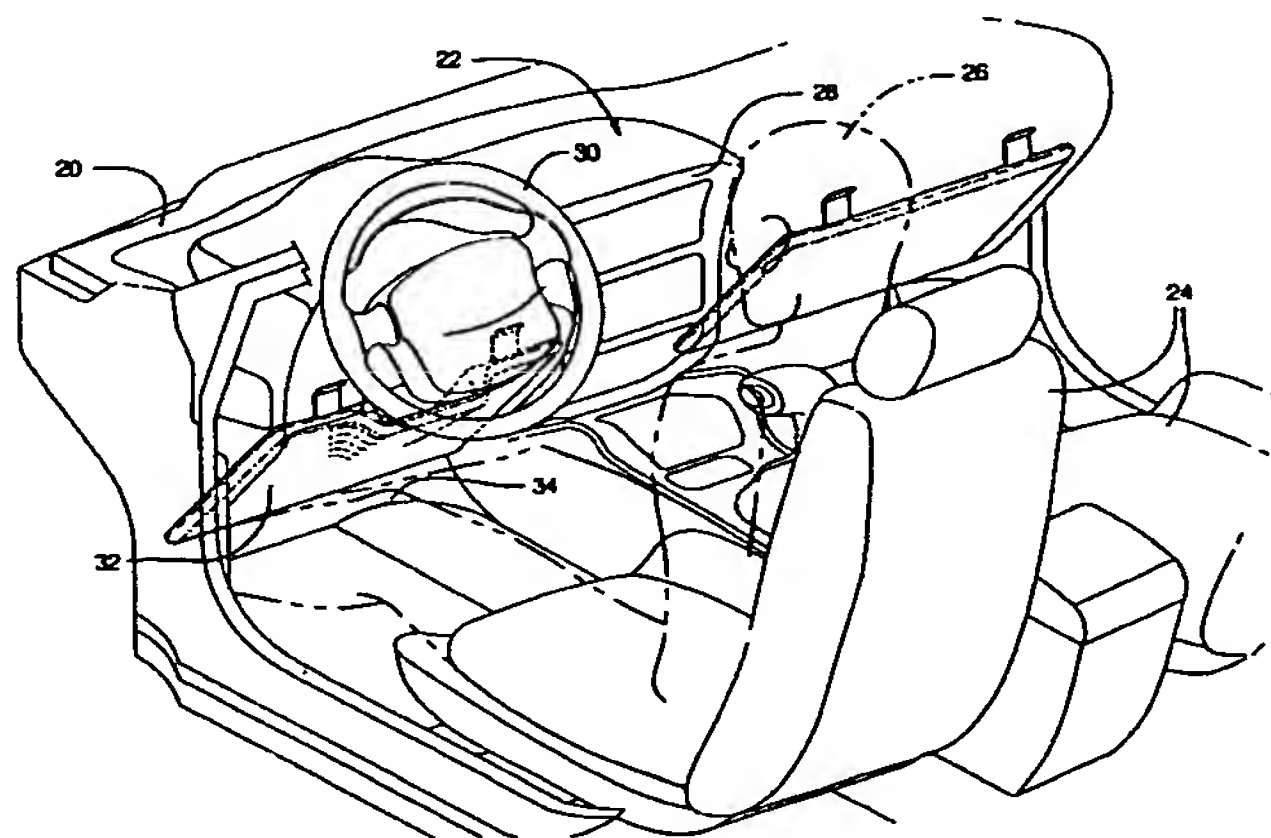
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ance Notes on Codes and Abbreviations" appearing at the begin-
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(54) Title: **INFLATABLE KNEE BOLSTER**



(57) Abstract: An inflatable knee bolster (232) for a vehicle occupant is mounted in opposing relation to the knees of a vehicle occupant. The bolster is an expansible chamber of multipiece construction having a face portion (238) and a separate three dimensional expansible body portion (240). The face portion (238) and body portion (240) are joined about their peripheries to define and substantially enclose the chamber. The expansible body portion (240) is formed from injection molded polymeric material and has one or more integrally molded at least partially collapsible pleated profile elements (259) disposed along the sides and across the top of the body portion (240) in raised and lowered profile with respect to the face portion (238). Deformable mounting brackets (277, 279) extend outwardly from the body portion (240) for attachment to the vehicle. The materials forming the face and body portions are of either similar or dissimilar chemical and physical character. Actuation of an inflator (270) in fluid communication with the bolster (232) pressurizes the expansible body (240) causing at least a portion of the pleated profile elements (259) to collapsibly deform such that the volume of the enclosed chamber is expanded and the face portion (238) is thrust outwardly to an extended position.

WO 01/51317 A1

INFLATABLE KNEE BOLSTER

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CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Serial No. 09/130,939 filed 7 August, 1998.

10 TECHNICAL FIELD

This invention is related generally to inflatable vehicle protective devices and, more particularly, to an inflatable knee bolster.

BACKGROUND OF THE INVENTION

15 Inflatable knee bolsters have been developed to enhance vehicle occupant protection in the event of sudden vehicle deceleration. Such devices increase the duration of deceleration of occupants' femurs and control upper torso kinematics during a frontal impact event. The bolster impact surface is moved from a stored position to an extended position to intercept an occupant's
20 knees early in the impact event. This allows the knees more time to decelerate to the vehicle's final velocity. The initial positioning of the bolster impact surface in a retracted, stored position allows more styling flexibility and enhances occupant ingress and egress.

Typical inflatable knee bolster installations comprise an inflatable air
25 bag sandwiched between an impact surface and a reaction surface. When the inflator is triggered, the air bag expands to move the impact surface a predetermined distance to active position. This position may be determined by tethers between the reaction and impact surfaces. These installations comprise numerous parts, bits and pieces and require careful installation.

30 It would be desirable to provide a simpler inflatable knee inflatable bolster which would be less costly to manufacture and assemble into the vehicle. To this end it is believed to be advantageous to utilize bolster

configurations which utilize a relatively small number of components which may be easily assembled and which exhibit effective deployment in an operational situation.

5 SUMMARY OF THE INVENTION

It is an object of this invention to provide a simpler inflatable knee bolster which would be less costly to manufacture and assemble into the vehicle.

10 This invention provides advantages and alternatives over typical prior knee bolster installations by providing an inflatable knee bolster which may be deployed from a stored state to an operational state by expansion of the bolster body itself. Such configuration reduces and more preferably eliminates any reliance on the use of an air bag within the bolster structure thereby reducing the complexity of assembly and installation and effecting a reduction in the number
15 of active components within the operating device.

In one aspect this invention features an inflatable bolster for a vehicle occupant having an outer wall that is projected outwardly from a stored position to an extended position by inflation of an expansible chamber by an inflator. The expansible chamber includes a unitary hollow body having an outer wall
20 and an inner wall interconnected by U-shaped normally folded accordion pleats. An attachment tab extends from the top of the chamber for attachment to vehicle structure, and another attachment tab extends from the bottom of the chamber for attachment to vehicle structure. Alternatively, the bottom of the outer surface could be attached directly to vehicle structure.

25 In another aspect of this invention, the bolster is an inflatable knee bolster having an outer wall that is projected outwardly to an extended position adjacent the occupant's knees by inflation of an expansible chamber by an inflator. The outer and inner walls are interconnected at their bottoms by a bottom wall and at their tops and sides by the accordion pleats which are U-
30 shaped and extend from the bottom side corners up the sides and across the top of the body. The top tab is a frangible tab which is broken by expansion of the expansible chamber, allowing the outer wall to pivot about the bottom wall and

extend . Preferably, tethers on the frangible tab limit movement of the outer wall. Also, vent holes are preferably included to provide subsequent controlled deflation of the expansible body. The hollow body is preferably a blow molding of polypropylene.

5 According to another aspect of the present invention, an inflatable knee bolster of multipiece construction is provided. The bolster is formed of separate portions forming the face and an expansible body which are joined about their peripheries. Formed within the body portion are a plurality of at least partially collapsible profile elements extending in raised and lowered profile within the
10 cavity between the face and the expansible body. At least a portion of the profile elements undergo collapsible deformation upon pressurization of the cavity by an inflator thereby expanding the volume of the cavity and forcing the face outwardly from a stored position to an extended position.

 According to yet other potentially preferred aspects of the invention, the
15 face portion and body portion of the bolster of multipiece construction are formed from injection molded polymeric materials. The materials forming the face portion and the body portion are preferably of different durometers such that the face portion is more rigid than the body portion. The materials forming the face and the body portions may be either of similar or dissimilar chemical
20 composition.

 According to yet further potentially preferred aspects of the present invention, the face portion and body portion of the bolster of multipiece construction are joined along their peripheries by mateable projectile and aperture elements with intermediate ridges therebetween . The projectile and
25 aperture elements are preferably fusion bonded to effect melt flow of the projectile elements within the aperture elements between the ridges.

 In accordance with other potentially preferred aspects of the present invention, the knee bolster includes mounting elements extending outwardly from the underside of the body portion facing away from the vehicle occupant
30 for attachment to the vehicle frame. The mounting elements are preferably metal brackets which undergo flexure and subsequent plastic deformation upon impact by a vehicle occupant.

Advantageously, the knee bolster according to the present invention serves to provide a construction which is easily assembled and may be expanded to its operable position either with or without the use of an internally disposed air bag component. The orientation of expansion elements and the materials of construction may be selected to provide preferential expansion of designated regions of the bolster to enhance design alternatives.

Additional objects features and advantages of the invention will be set forth in part in the description which follows, and in part will be obvious from the description. While the invention is illustrated and will be described in connection with potentially preferred embodiments, it is to be understood that such illustration and description are exemplary and explanatory only and are in no way to be construed as restrictive of the invention. On the contrary, it is the intent of the applicants to cover all alternatives, modifications, and equivalents as may be included within the true spirit and scope of the invention as limited only by the full scope of allowable claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of the driver's side of a vehicle passenger compartment showing the position of an inflatable knee bolster of this invention in stored position:

Fig. 2 is a front view of the inflatable knee bolster illustrated in FIG. 1:

Fig. 3 is a rear view of the inflatable knee bolster of FIG. 1:

Fig. 4 is a sectional view taken along line 4 – 4 of Fig. 3:

Fig. 5 is a sectional view taken along line 5 – 5 of Fig. 3:

Fig. 6 is a sectional view taken along line 6 – 6 of Fig. 3:

Fig. 7 is a partial side view of the passenger compartment of Fig. 1, showing the inflatable knee bolster in stored position:

Fig. 8 is a view similar to Fig. 7, showing the inflatable knee bolster in extended position:

Fig. 9 is a rear view of another embodiment of inflatable knee bolster according to this invention;

Fig. 10 is a sectional view taken along line 10 – 10 of Fig. 9;

Fig. 11 is a sectional view taken along line 11 – 11 of Fig. 9

5 Fig. 12 is an exploded perspective view of a further embodiment of an inflatable knee bolster according to this invention comprising at least two discrete panel sections;

Fig. 13 is an interior view of the face-forming panel of the inflatable knee bolster illustrated in Fig. 12;

10 Fig. 14 is a plan view of the underside of the body portion of the inflatable knee bolster illustrated in Fig. 12;

Figs. 15A and 15B illustrate a potential arrangement for attachment of the panel elements illustrated in Fig. 12;

Fig. 16 is a sectional view taken along line 16 - 16 of Fig. 14;

15 Fig. 17 is a sectional view taken along line 17 - 17 of Fig. 14;

Fig. 18 is a sectional view taken along line 18 - 18 of Fig. 14; and

Fig. 19 is a view similar to Fig. 18 illustrating the knee bolster of Fig. 12 in expansion.

20 DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Fig. 1, an automotive vehicle 20 has a passenger compartment 22 that includes front seats 24 for the occupants, including a driver 26. The usual instrument panel 28 flanks the steering wheel 30. An inflatable knee bolster 32 is mounted on the underside of instrument panel 28 adjacent the
25 knees 34 of driver 26. A similar arrangement is provided for the passenger. Knee bolster 34 is nearly flush with the underside of instrument panel 28, as best seen in Fig. 8.

Referring now to Figs. 2 – 7, knee bolster 32 comprises a unitary hollow main body 36 formed of a blow molded polypropylene-based or other
30 thermoplastic material. Main body 36 includes a front or outer wall 38 and a spaced inner wall 40 that are interconnected by a bottom wall 42. At their tops

and sides. outer wall 38 and inner wall 40 are interconnected by inverted U-shaped accordion pleats 44 and 46 which are normally folded. as shown.

A pair of transverse strengthening ribs 48 and 50 are formed in inner wall 40 and extend inwardly of body 36 into engagement with the rear side of outer wall 38. as best seen in Fig. 5. A pair of integral lower mounting tabs 52 and 54 extend from bottom wall 42 for attachment by screws 56 to the bottom 58 of instrument panel 28 as best seen in Fig. 7. A pair of integral upper frangible mounting tabs 60 and 62, having weakened sections 60' and 62', extend upwardly from body 36 for attachment to instrument panel bottom 58 by screws 56. A tether 64 is fastened by screws 56 to both ends of upper mounting tabs 60 and 62.

A cavity 66 is formed in inner wall 40 and includes an opening 68 for receiving a cylindrical inflator 70. that is bolted at 72 to the upper wall of cavity 66. as best shown in Figs. 3 and 6. Inner wall 40 also includes a pair of spaced vent holes 76 and 78, as shown in Fig. 3. With this unitary construction, main body forms a hollow chamber 80 that is air tight except for vent holes 76 and 78.

In the event of vehicle deceleration during a frontal impact event. an acceleration sensor (not illustrated) actuates inflator 70. which pressurizes main body 36. This forces main body 36 to expand by breaking frangible tabs 60 and 62 at 60' and 62' and unfolding accordion pleats 44 and 46. This projects bolster outer wall 38 outwardly to the extended position shown in Fig. 8 adjacent occupant's knees 34. This movement to extended position is limited by the length of tethers 64. Thus. bolster outer wall 38 is in position to engage the occupant's knees 34 and lower leg to increase their duration of deceleration during vehicle deceleration.

An alternative embodiment of inflatable knee bolster. denoted 134. is shown in Figs. 9 – 11. where parts similar or identical to parts in the Figs. 1 – 8 embodiment are identified by like numbers increased by 100. Here. the main difference is the inclusion of four spaced vertical strengthening ribs 80. 82. 84 and 86 which are formed in inner wall 140. These replace ribs 48 and 50 in the

Figs. 1 – 8 embodiment and provide the same strengthening function.

Functioning of this embodiment is the same.

A further embodiment of an inflatable knee bolster 232 of multipiece construction is illustrated in Fig. 12 wherein the front wall 238 forming the face portion of the knee bolster 232 and a three dimensional expansible body portion 240 are formed as separate panels which are joined in sealed relation about their peripheries as will be described further herein.

The front wall 238 forming the face portion of the knee bolster preferably has a substantially smooth outer surface which may be contoured for disposition within the underside of the vehicle instrument panel. As shown in Fig. 13, the underside of the front wall 238 preferably includes a number of integrally molded male projectile elements 247 extending generally around the periphery of the underside for use in securing attachment to the panel forming the body portion 240. In the illustrated and potentially preferred embodiment, the projectile elements 247 are of a generally hollow ellipsoidal geometry having substantially straight sides connected by curved ends and are of a height sufficient for mateable insertion and upward extension through corresponding apertures 249 disposed around the periphery of the body portion 240 (Fig. 14).

As best illustrated in Fig. 12, the front wall 238 forming the face portion of the knee bolster 232 is preferably of unitary construction having a raised perimeter edge 251 surrounding the interior surface thereby forming a tray-like structure. As illustrated, the body portion 240 preferably includes a perimeter wall 253 which is mateable in nesting relation within the perimeter edge 251 of the front wall 238 such that male projectile elements 247 extend upwardly through the corresponding apertures 249 which are disposed within a channel 257 between the perimeter wall 253 and adjacent expandable perimeter profile elements 259 which are preferably of a raised and lowered accordion configuration. This mating relationship is best illustrated in Figs. 15A and 15B.

The projectile elements 247 may be held in place within the apertures 249 by joining techniques as are known to those of skill in the art including by way of example only and not limitation, sonic welding, vibration welding, laser welding, thermal melt bonding, adhesive bonding and combinations thereof.

One potentially preferred method of attachment involves use of a moveable sonic welder 263 (Fig. 15B) operating a frequency of about 20 MHz.

According to the illustrated embodiment, rib-like ridges 265 of substantially right triangular configuration are disposed inboard of the perimeter wall 253 of the body portion 240 between the apertures 249. Such ridges 265 may serve as weirs for the containment of melt material which flows outwardly from the projectile containing apertures during the melt bonding operation and in some configurations may provide additional support if desired.

Although the mateable bonding of projectile elements 247 within corresponding apertures 249 may represent one mechanism for the joinder of the discrete portions of the knee bolster 232, it will be appreciated that a host of other mechanisms may likewise be utilized either independently or in combination which do not rely upon such geometries. Such attachment mechanisms include by way of example only, direct mechanical attachment, smooth service welding or chemical adhesion.

In the illustrated embodiment, the body portion 240 comprises a unitary panel which extends away from the front wall facing generally away from the vehicle occupant and towards the engine compartment. While panels of unitary molded construction may be preferred, it is to be understood that the panels forming the body portion 240 as well as the front wall 238 may likewise be formed from two or more pieces which are later joined together.

As previously referenced, and best illustrated in Figs. 16-18, the underside of the body portion 240 preferably includes one or more integrally formed perimeter profile elements 259 extending in raised and lowered relief with respect to the front wall 238 inboard of and substantially adjacent to the line of attachment between the front wall 238 and the body portion 240. As shown, the perimeter profile elements 259 are preferably arranged in a wave form accordion orientation and occupy a relatively wide band extending along the top edge of the body portion 240. These perimeter profile elements 259 preferably taper away as they extend down the lateral sides of the body portion 240. In addition, in the illustrated and potentially preferred embodiment,

interior rib profile elements 269 extend from the back of the body portion 240 towards the front wall 238.

The underside of the body portion 240 preferably includes an integral molded chamber for housing an inflator 270 as illustrated. However, as will be appreciated, the inflator 270 may likewise be housed in a location remote from the knee bolster 232 and be connected thereto by tubing or other fluid communication means.

According to the illustrated embodiment, raised attachment surfaces 273, 275 of elongated tapered profile preferably extend outwardly from the underside of the body portion 240 for attachment to brackets 277, 279 by retaining pins 281 (Fig. 12). The brackets 277, 279 are preferably of an inwardly angled profile and are formed of a material such as light gauge steel of about 2 mm thickness or like material to facilitate energy absorptive flexure followed by plastic deformation upon impact. As will be appreciated, such brackets 277, 279 may be mounted in supported relation to the vehicle frame by screws 285 or other attachment devices as may be known to those of skill in the art.

In the event of a collision event which does not give rise to deceleration values sufficient to activate the inflator 270, it is believed that in some applications the brackets 277, 279 may nonetheless provide a degree of energy absorption through flexure and subsequent plastic deformation upon impact by an occupant. Bracket structures formed from plastically deformable material such as metal and having geometries which facilitate controlled bending under compression may be preferred for some applications.

Referring now to Figs. 18 and 19, upon the occurrence of an impact event causing sufficient vehicle deceleration, the inflator 270 is actuated and releases a pressurizing medium which flows into the chamber 291 created by the enclosure between the face forming front wall 238 and the body portion 240. Upon pressurization of the interior, both the perimeter profile elements 259 and the interior rib profile elements 269 preferably undergo at least a partial collapse thereby increasing the volume of the chamber and placing the underside of the body portion into compression as the profile elements 259, 269 seek a flattened profile as they are pushed away from the front wall 238. Since the body portion

240 is held substantially rigidly in place in relation to the vehicle frame, the compressive stress is relieved by thrusting the front wall 238 outwardly to an operational position adjacent to the knees of the occupant.

As will be appreciated, the degree to which the front wall 238 is outwardly thrust will depend largely upon the surface area of the profile elements which undergo deformation. The preferential concentration of perimeter profile elements 259 extending along the upper edge of the knee bolster 232 will tend to provide preferential rotatable extension of the bolster at that region, while the interior rib profile elements 26 tend to distend the front wall as a whole. The orientation and concentration of such elements may thus be adjusted to facilitate characteristics of extension as may be desired for a given application. It is, of course to be understood that breakaway tethered attachment constructions including those as illustrated in Figs. 2, 7 and 8 may also be utilized if desired.

In order to facilitate preferential pressurized expansion of the body portion 240, in some applications it may be desirable that the materials forming the front wall 238 and body portion 240 are such that the face portion is more rigid than the body portion and is therefore less likely to undergo deformation. Such differential rigidity may be achieved by adjusting the thickness of the components or by using polymers of differing durometer for the front wall and body portions. Potentially preferred materials for forming both the front wall and the body portion of the knee bolster are injection molded polymers, including by way of example only, polypropylenes, polycarbonates, polyurethanes and other suitable thermoplastic materials.

It is believed that injection molding of the panels forming the front wall 238 and the body portion 240 may permit the achievement of extremely close tolerances which may be desirable for some applications. Other molding techniques as may be known to those of skill in the art including by way of example only, compression molding, extrusion and the like may also be utilized.

It is contemplated that the materials forming the front wall 238 and body portion 240 may be either of similar or dissimilar chemical composition. According to one embodiment, the front wall 238 is formed from an injection

molded polycarbonate thermoplast of high rigidity and impact strength while the body portion 240 is formed from a flexible injection molded polyurethane rubber. The use of materials of such differential rigidity tends to facilitate the preferential expansion of the body portion 240, while permitting the front wall
5 to be substantially unaltered. Such performance characteristics may be desirable in certain applications.

While the present invention has been described as carried out in specific embodiments thereof, it is not intended to be limited thereby, but is intended to cover the invention broadly within the scope and spirit of the appended claims.

CLAIMS

1. An expansible knee bolster (232) for a vehicle occupant that is projected outwardly from a stored position to an extended position adjacent the occupant's knees by inflation of an expansible chamber by an inflator (270) during a collision event, said knee bolster comprising:

a hollow enclosure of multipiece construction having a face portion (238) and a separate three dimensional expansible body portion (240) joined to said face portion (238) about the periphery of said face portion (238) such that an expansible chamber is formed between said face portion (238) and said body portion (240);

said expansible body portion (240) having a plurality of at least partially collapsible raised profile elements (259, 269) formed within said expansible body portion (240) and extending towards said face portion (238) such that upon pressurization of said expansible chamber by said inflator (270), at least a portion of said profile elements (259, 269) undergo collapsible deformation thereby expanding the volume of said chamber and forcing said face portion (238) outwardly to an extended position.

2. The expansible knee bolster (232) of claim 1, wherein said expansible body portion (240) includes an integral receptacle for housing said inflator (270).

3. The expansible knee bolster (232) of claim 1, wherein said expansible body portion (240) is a one piece structure.

4. The expansible knee bolster (232) of claim 1, wherein said face portion (238) and said expansible body portion (240) are formed from injection molded polymeric materials.

5. The expansible knee bolster (232) of claim 4, wherein said face portion (238) and said expansible body portion (240) are formed from polymeric materials of differing durometers.

5 6. The expansible knee bolster (232) of claim 4, wherein the polymeric material forming said face portion (238) has a chemical structure which differs from the polymeric material forming said expansible body portion (240).

10 7. The expansible knee bolster (232) of claim 1, wherein the material forming said face portion (238) is more rigid than the material forming said expansible body portion (240).

15 8. The expansible knee bolster (232) of claim 1, wherein said face portion (238) is joined to said body portion (240) by attachment means selected from the group consisting of: sonic welding; vibration welding; adhesive bonding; mechanical connection; and combinations thereof.

20 9. The expansible knee bolster (232) of claim 1, wherein said face portion (238) includes a plurality of projectile elements (247) extending at least partially around the periphery of said face portion (238), said projectile elements (247) being engageably mateable to corresponding apertures (249) disposed at least partially around the periphery of said expansible body portion (240).

25 10. The expansible knee bolster (232) of claim 9, further comprising raised elements (265) disposed between adjacent apertures (249) around the periphery of said expansible body portion (240).

30 11. The expansible knee bolster (232) of claim 9, wherein said face portion (238) is joined to said expansible body portion (240) by controlled welding of said projectile elements (247) within said corresponding apertures (249).

12. The expansible knee bolster (232) of claim 1, further comprising mounting elements (277, 279) extending outwardly from said expansible body portion (240) for attachment to the vehicle.

5 13. The expansible knee bolster (232) of claim 12, wherein said mounting elements (277, 279) comprise deformable brackets.

14. The expansible knee bolster (232) of claim 13, wherein said brackets (277, 279) are formed from metal.

10

15. An expansible knee bolster (232) for a vehicle occupant that is projected outwardly from a stored position to an extended position adjacent the occupant's knees by inflation of an expansible chamber by an inflator (270) during a collision event, said knee bolster (232) comprising:

15 a hollow enclosure of multipiece construction having a face portion (238) and a separate three dimensional expansible body portion (240) joined to said face portion (238) about the periphery of said face portion (238) such that an expansible chamber is formed between said face portion (238) and said body portion (240);

20 said expansible body portion (240) being formed from injection molded polymeric material and having one or more integrally molded at least partially collapsible pleated profile elements (259) disposed along the sides and across the top of said expansible body portion (240), such that upon pressurization of said expansible chamber by said inflator (270), at least a portion of said profile
25 elements (259, 269) undergo collapsible deformation thereby expanding the volume of said chamber and forcing said face portion (238) outwardly to an extended position.

16. The expansible knee bolster (232) of claim 15, wherein said
30 expansible body portion (240) further includes one or more deformable ribs (269) disposed across the interior of said expansible body portion.

17. The expansible knee bolster (232) of claim 15, wherein said face portion (238) and said body portion (240) are formed from polymeric materials of differing durometer such that said face portion (238) is more rigid than said expansible body portion (240).

5

18. The expansible knee bolster (232) of claim 15, further comprising mounting brackets (277, 279) extending outwardly from said expansible body portion (240) for attachment to the vehicle.

10

19. The expansible knee bolster (232) of claim 18, wherein said mounting brackets (277, 279) are deformable during an impact event.

15

20. An expansible knee bolster (232) for a vehicle occupant that is projected outwardly from a stored position to an extended position adjacent the occupant's knees by inflation of an expansible chamber by an inflator (270) during a collision event, said knee bolster comprising:

a hollow enclosure of multipiece construction having a face portion (238) including a peripheral edge, a separate three dimensional expansible body portion (240) joined to said face portion about said peripheral edge of said face portion such that an expansible chamber is formed between said face portion and said body portion and deformable mounting brackets (277, 279) extending outwardly from said expansible body portion (240) for attachment to the vehicle;

said expansible body portion (240) including a receptacle for housing said inflator (270) and being formed from injection molded polymeric material of lower rigidity than said face portion (238) and having one or more integrally molded at least partially collapsible pleated profile elements (259) disposed along the sides and across the top of said expansible body portion in raised and lowered profile with respect to said face portion (238), and one or more deformable ribs (269) disposed across the interior of said expansible body portion (240) such that upon pressurization of said expansible chamber by said inflator (270), at least a portion of said profile elements (259, 269) undergo

30

collapsible deformation thereby expanding the volume of said chamber and forcing said face portion (238) outwardly to an extended position

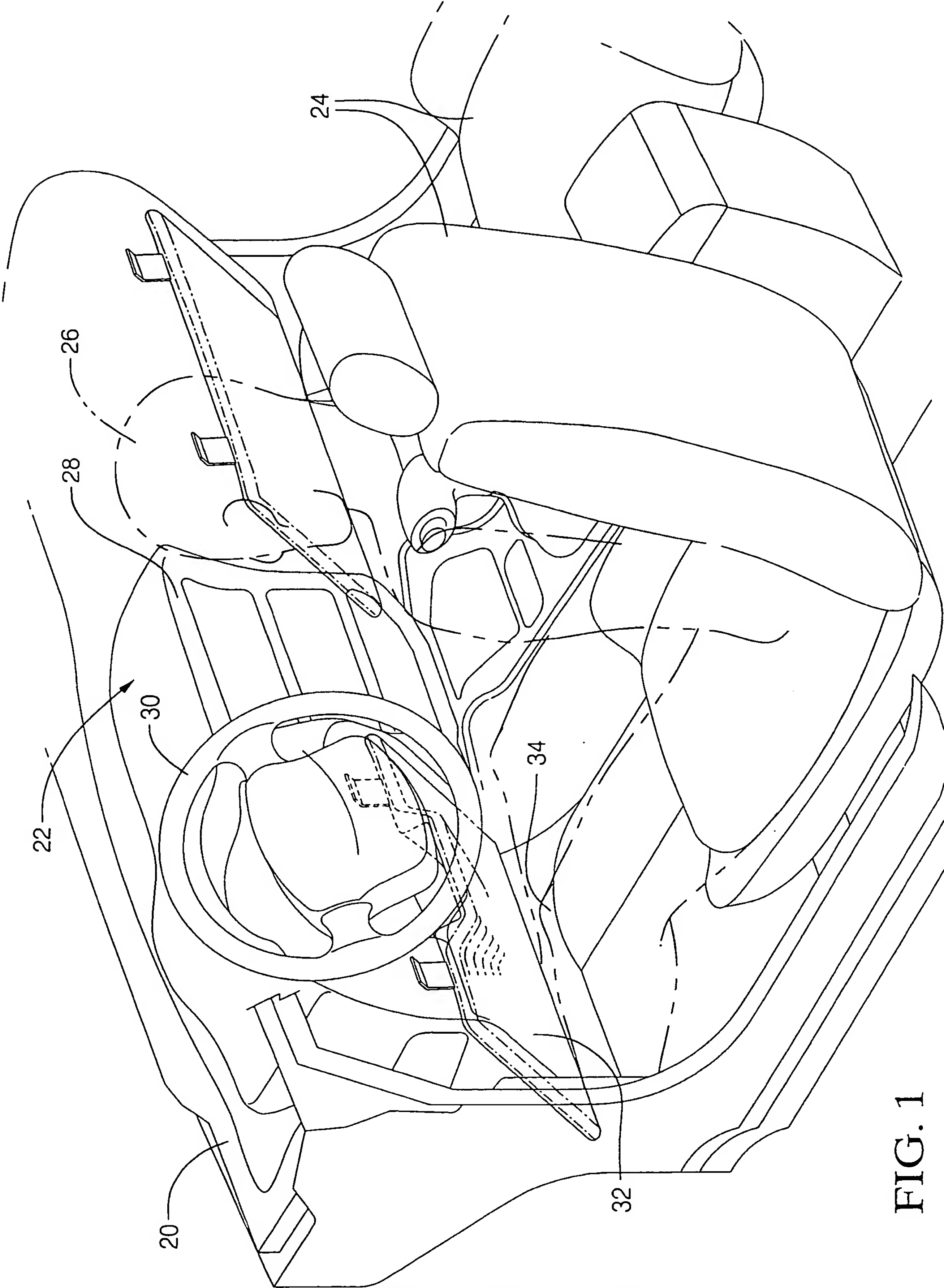


FIG. 1

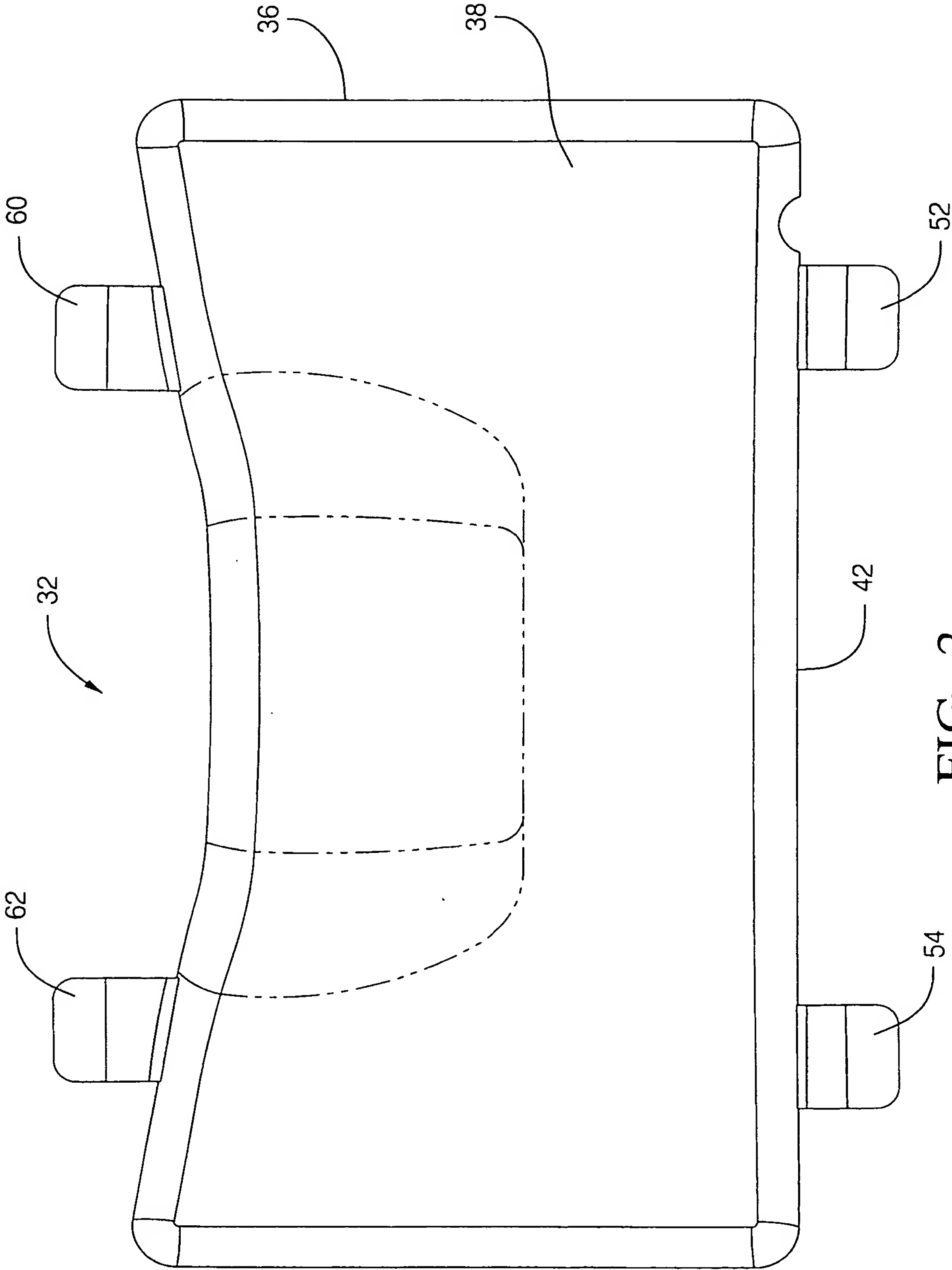
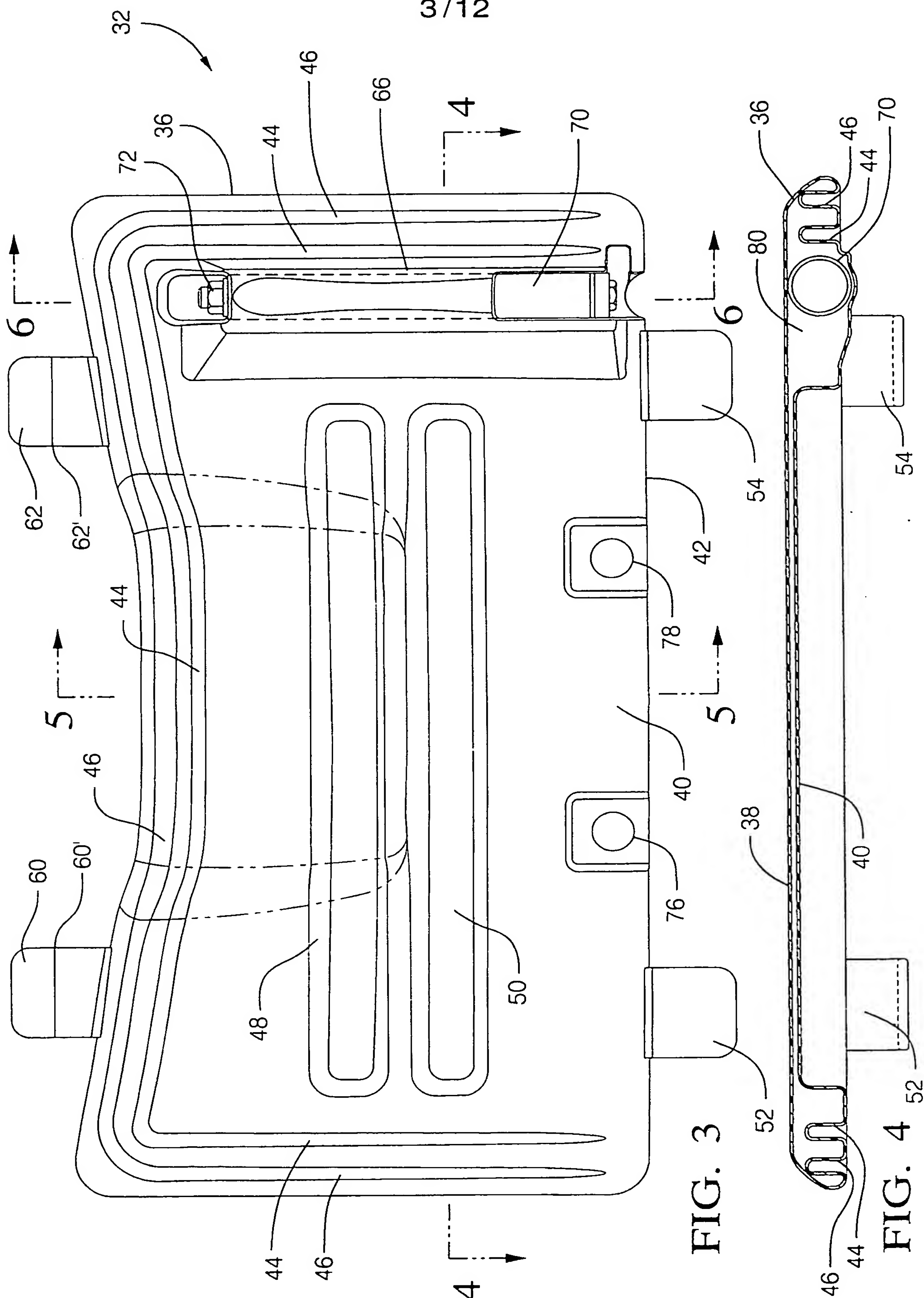
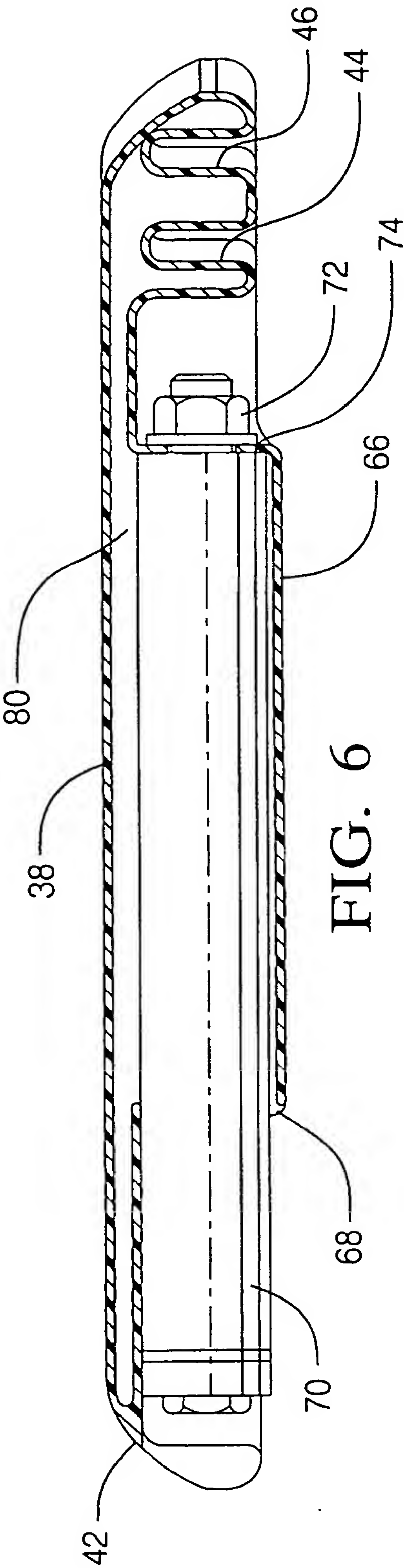
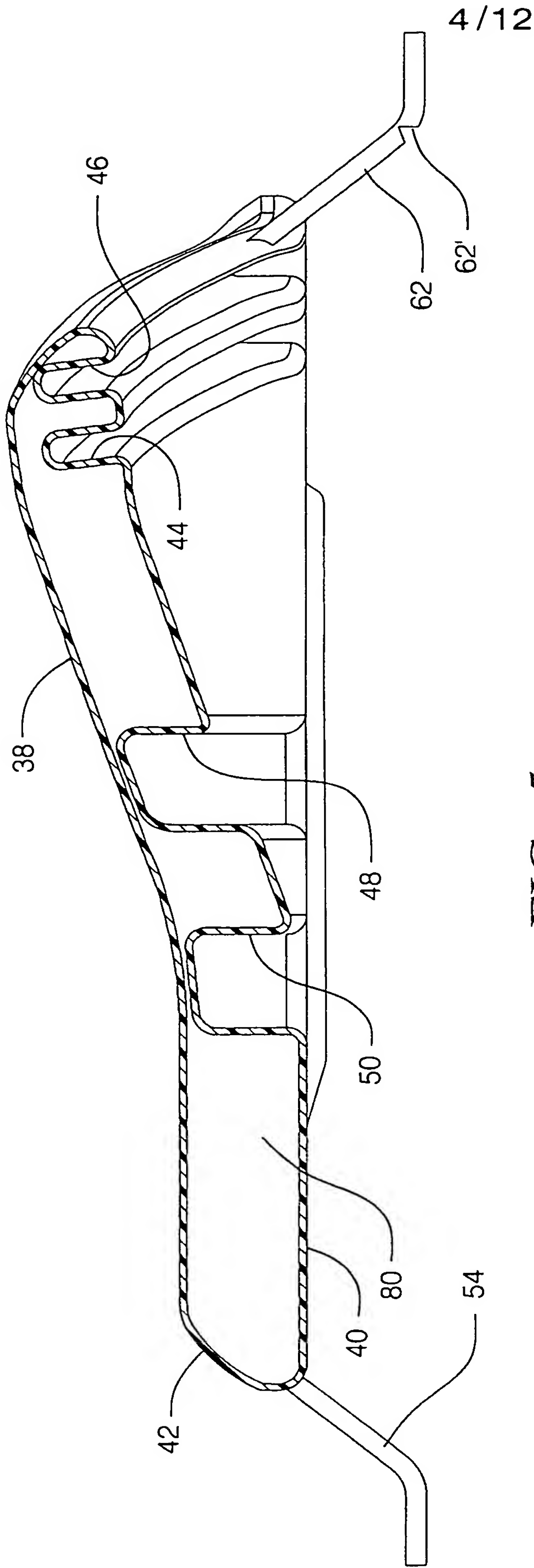


FIG. 2





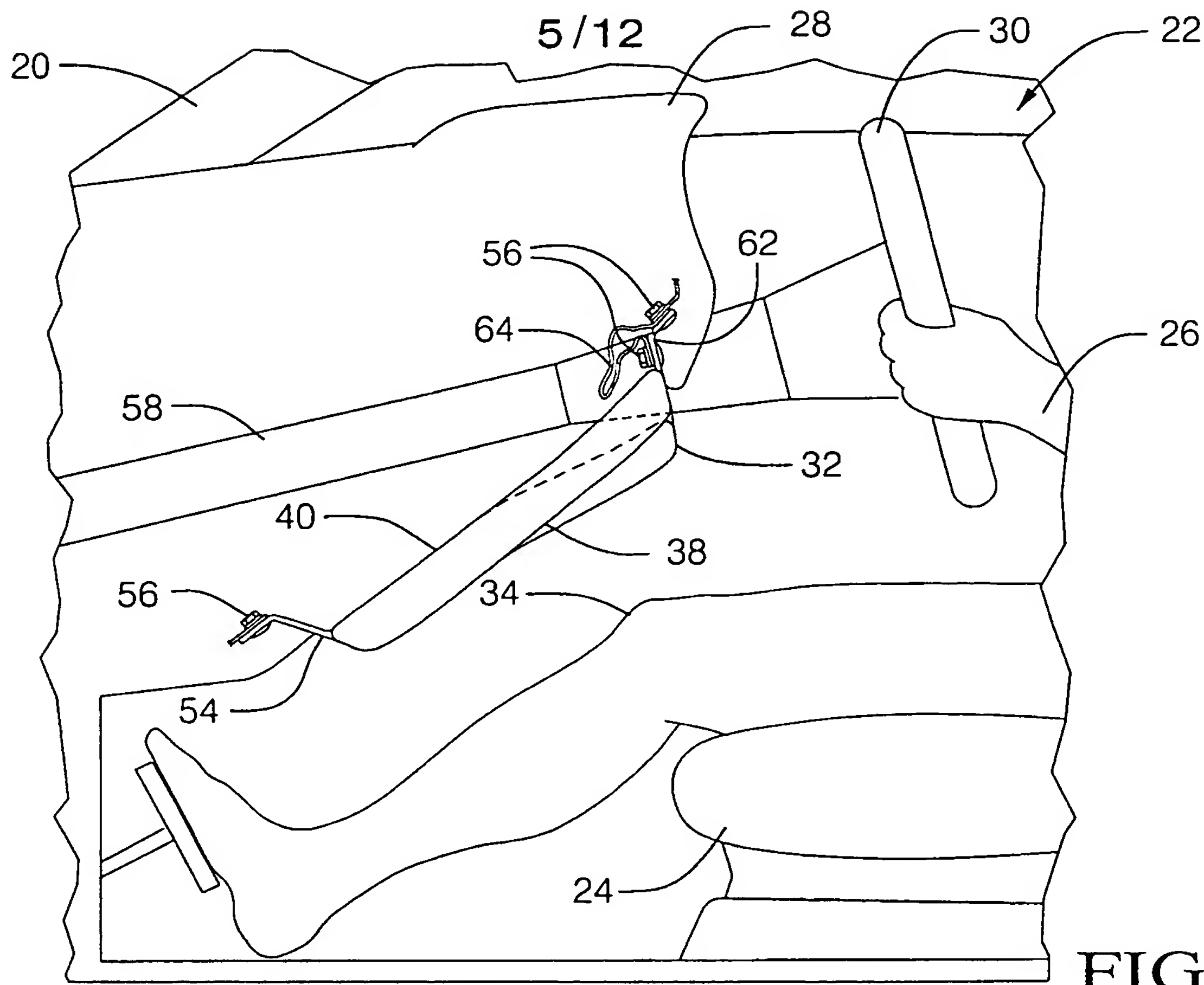


FIG. 7

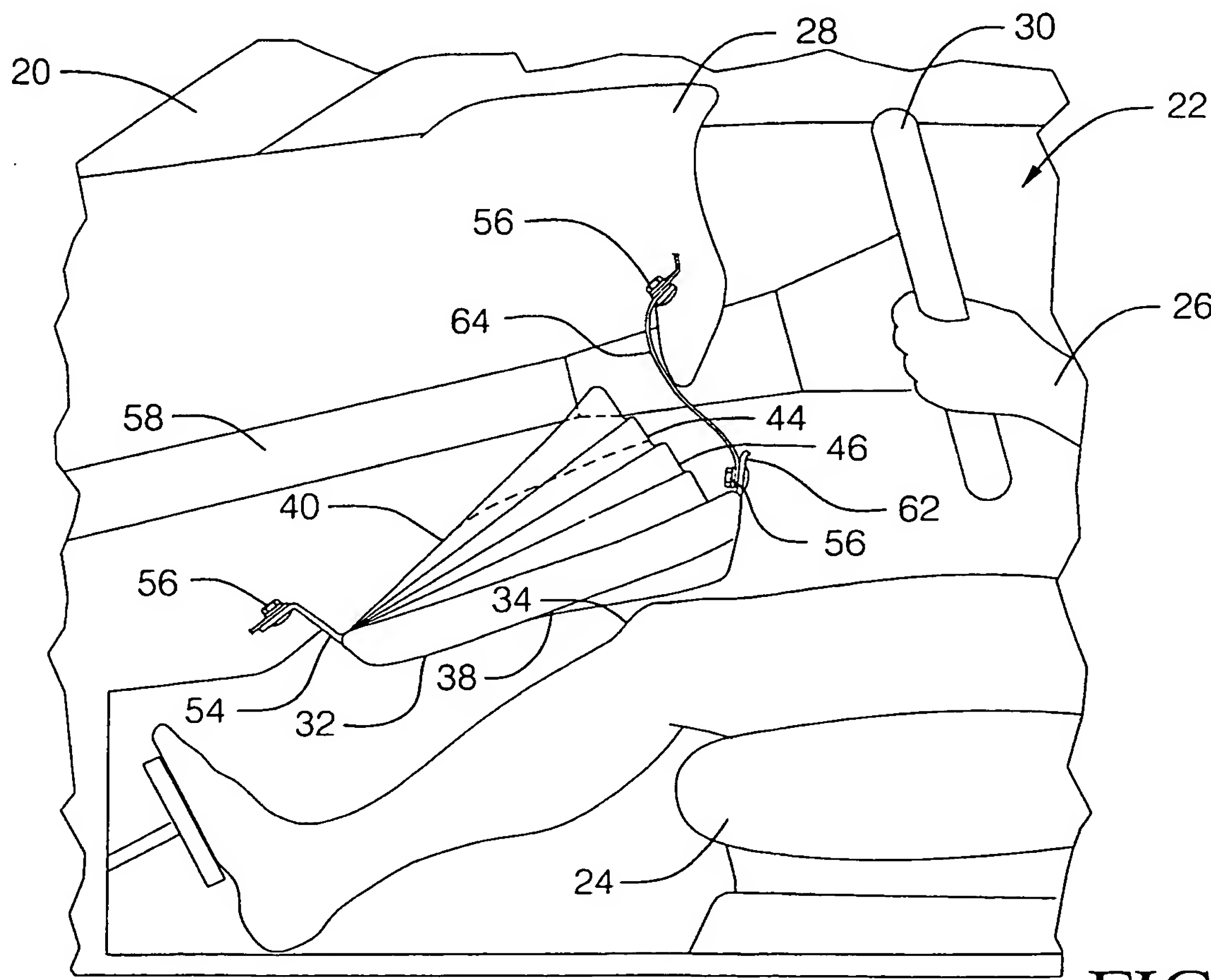


FIG. 8

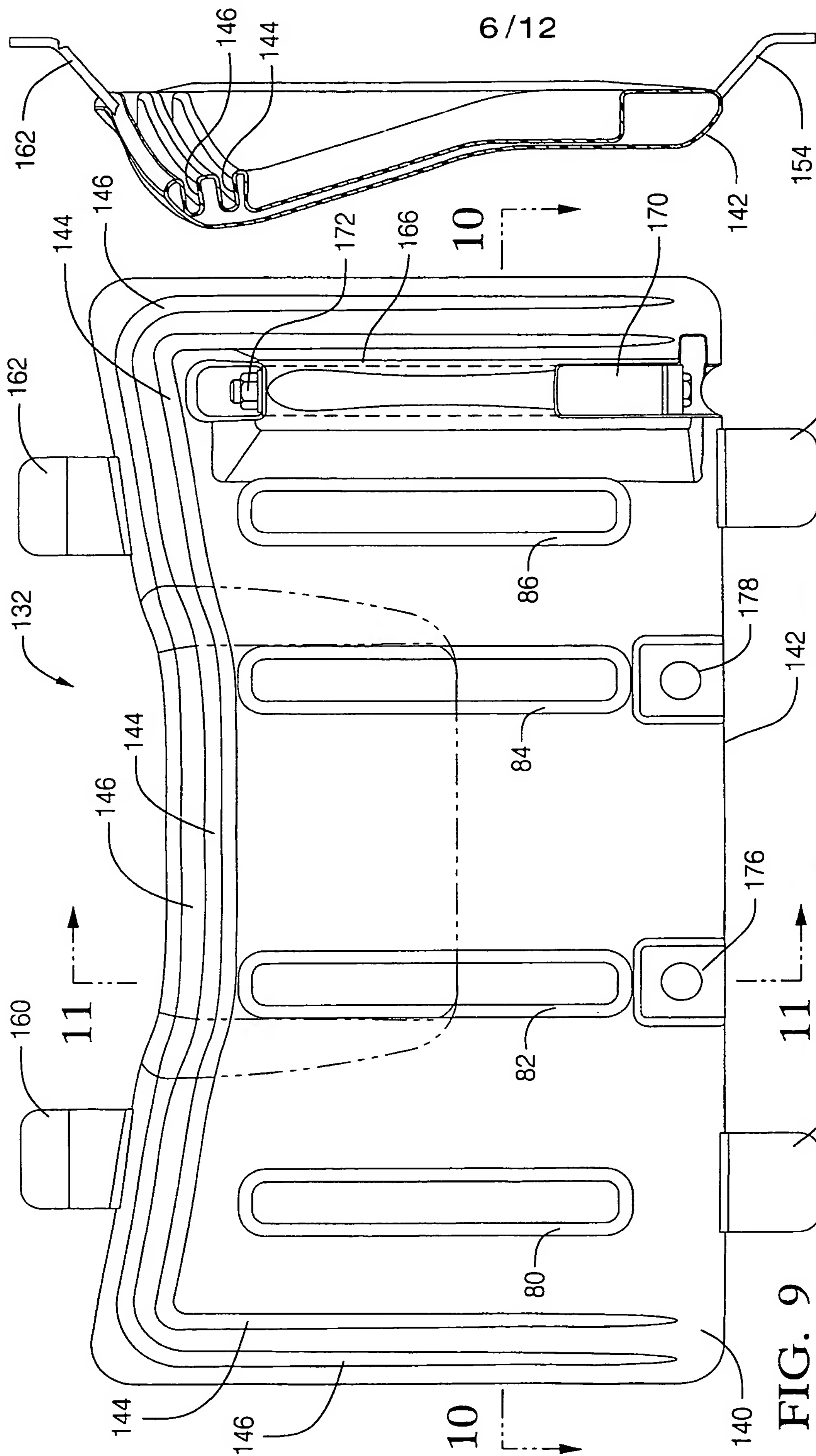


FIG. 11

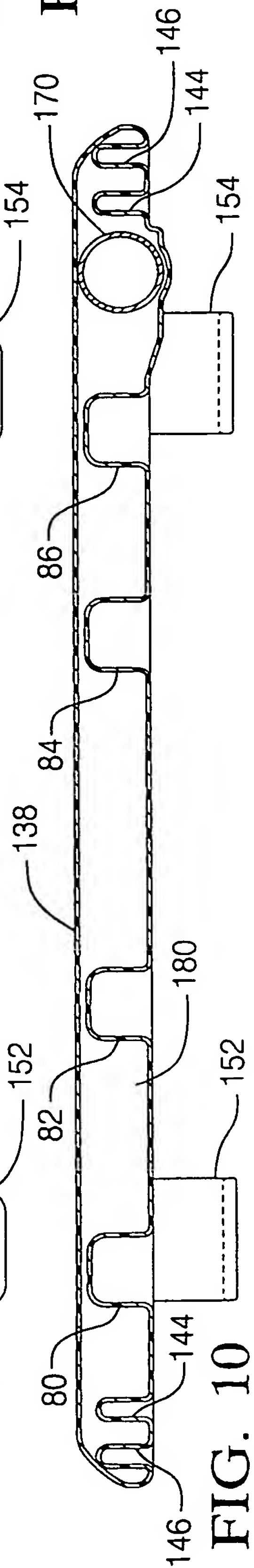


FIG. 10

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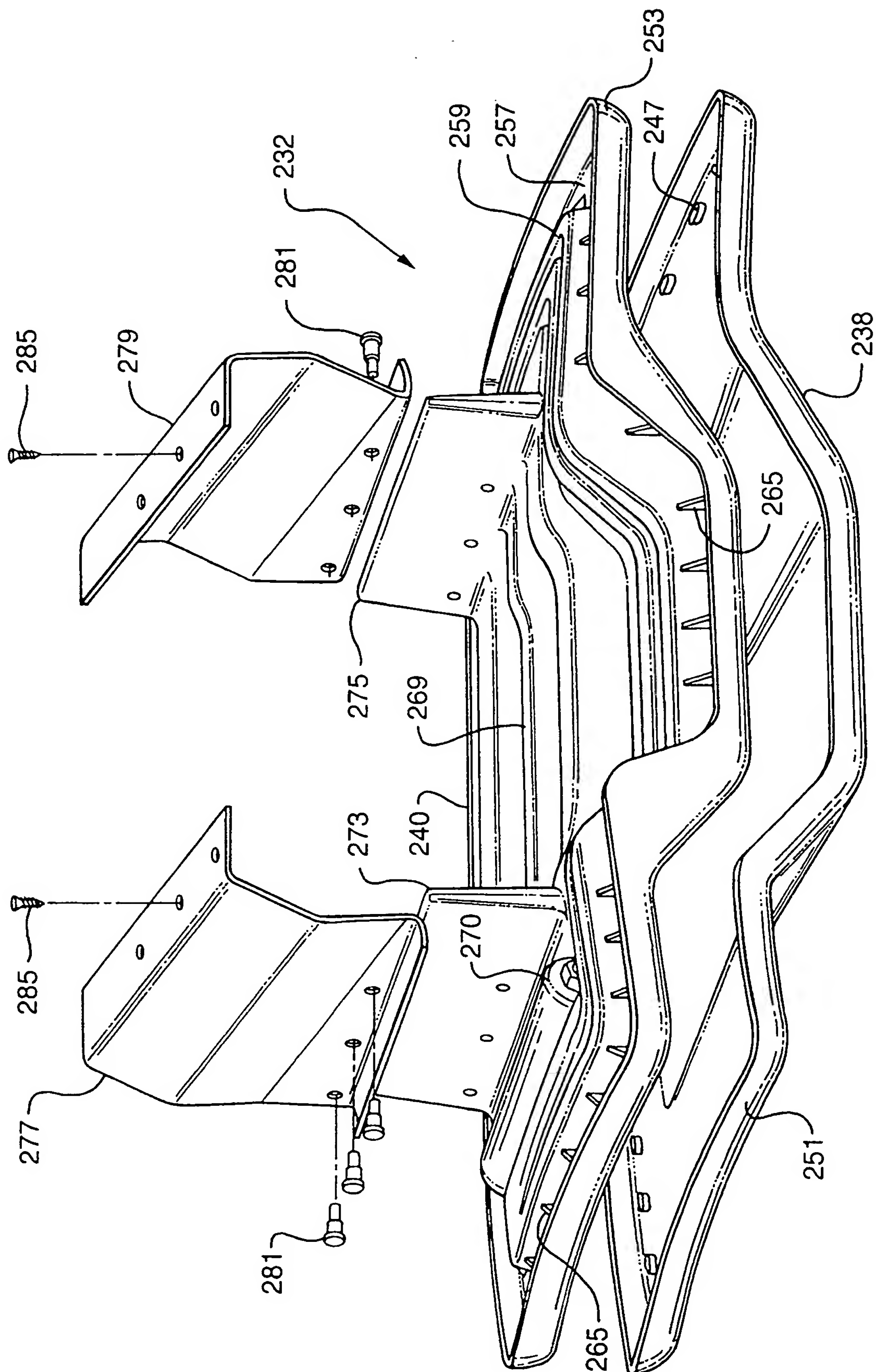


FIG. 12

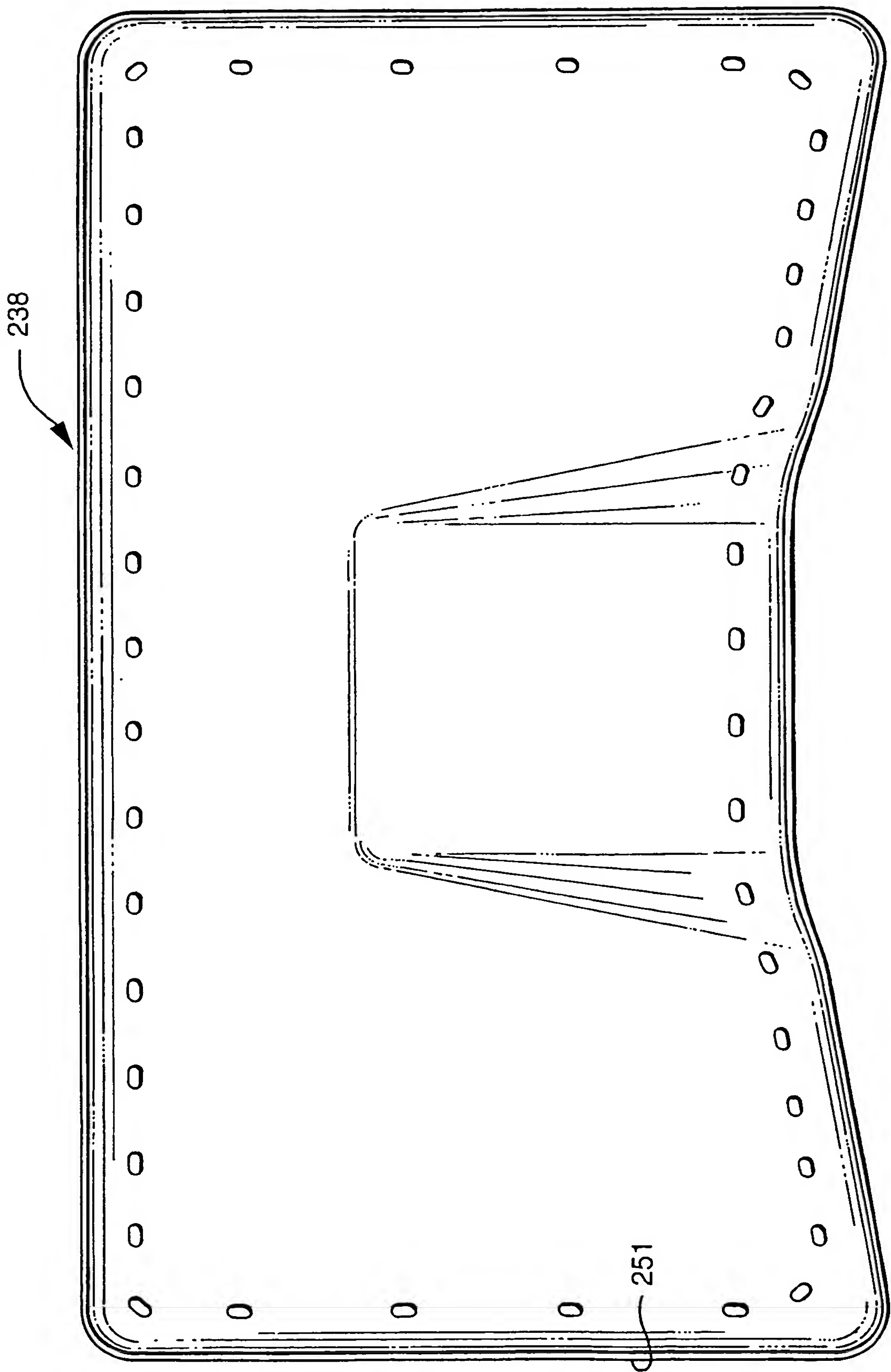


FIG. 13

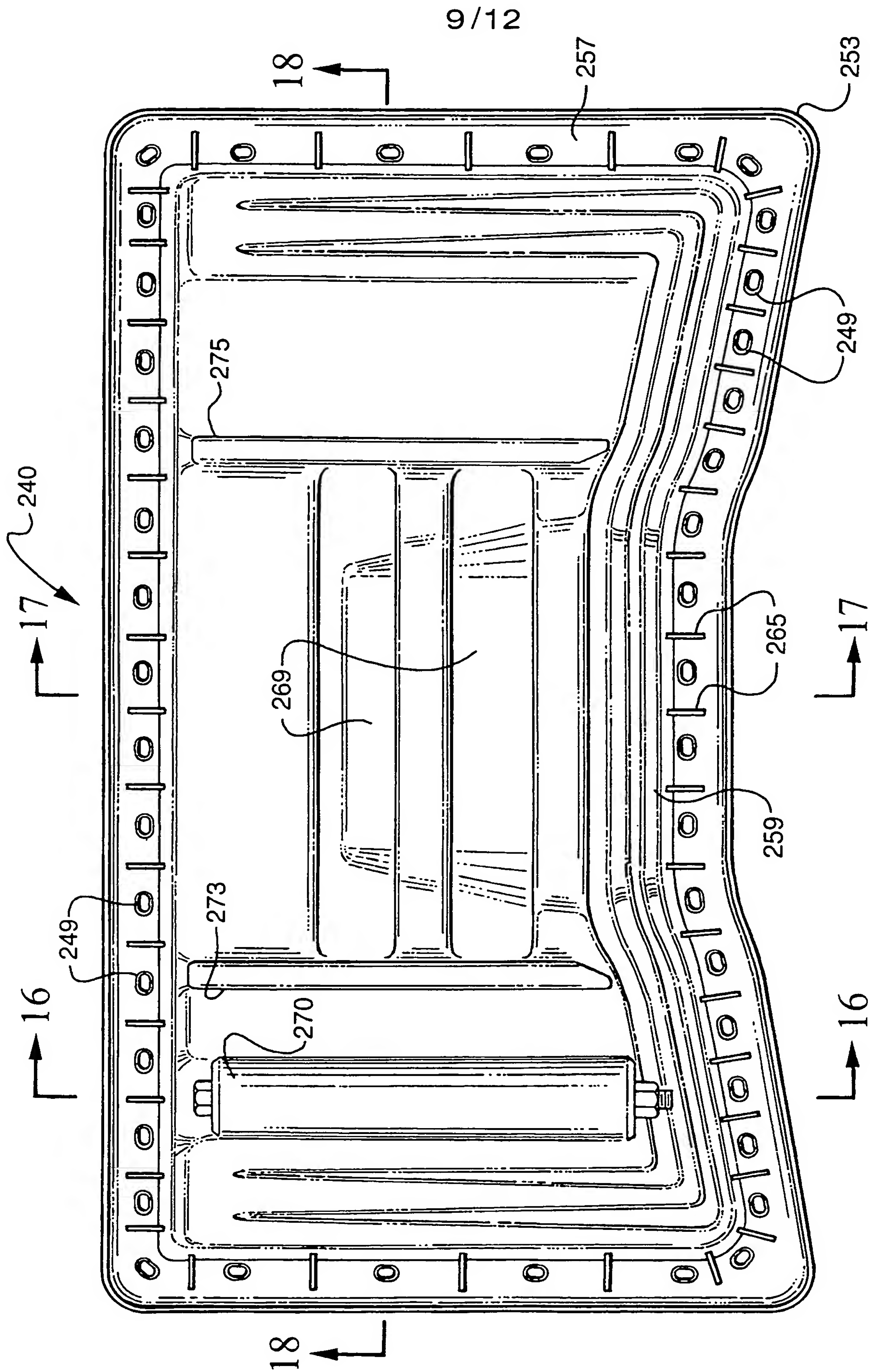


FIG. 14

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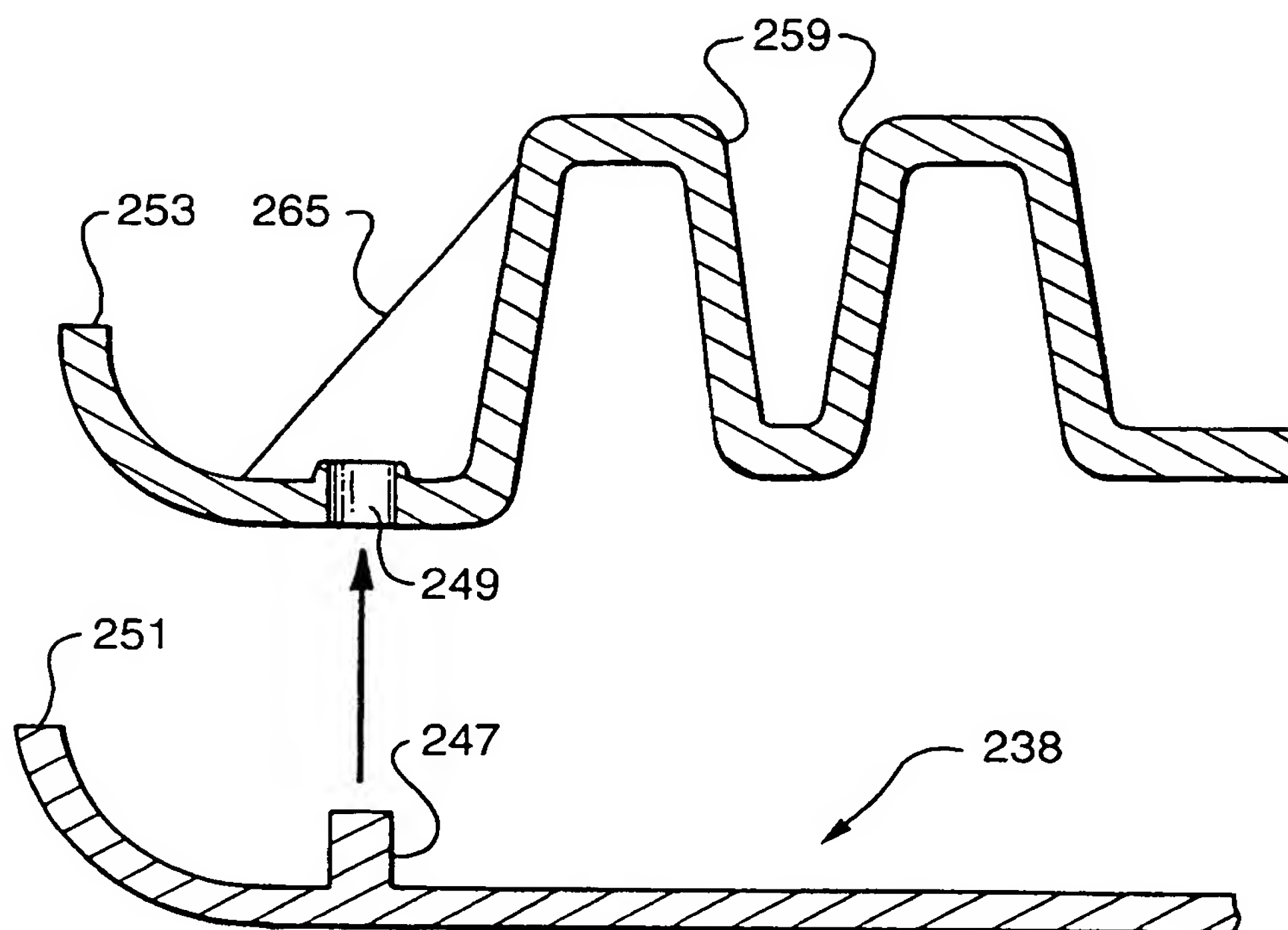


FIG. 15A

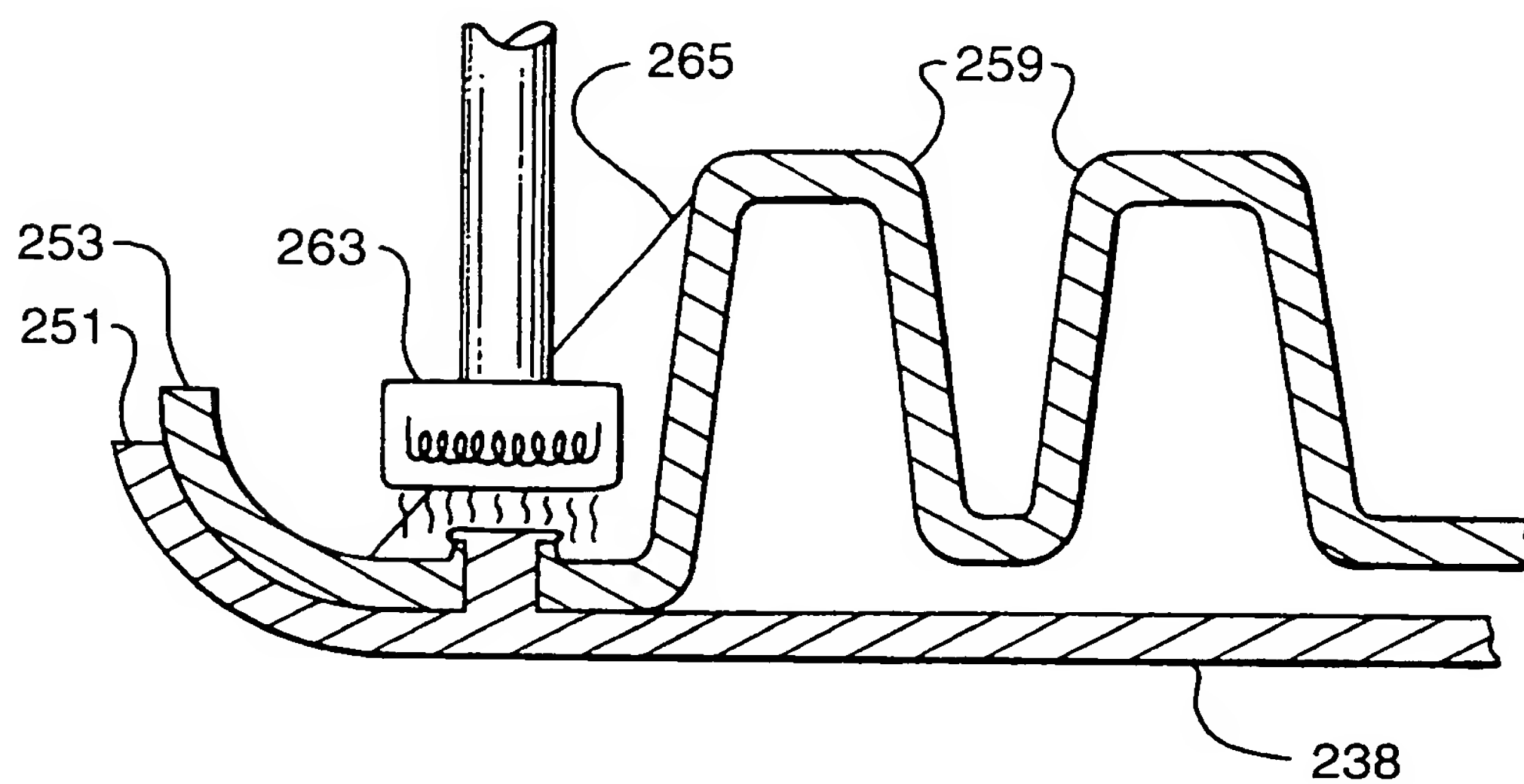


FIG. 15B

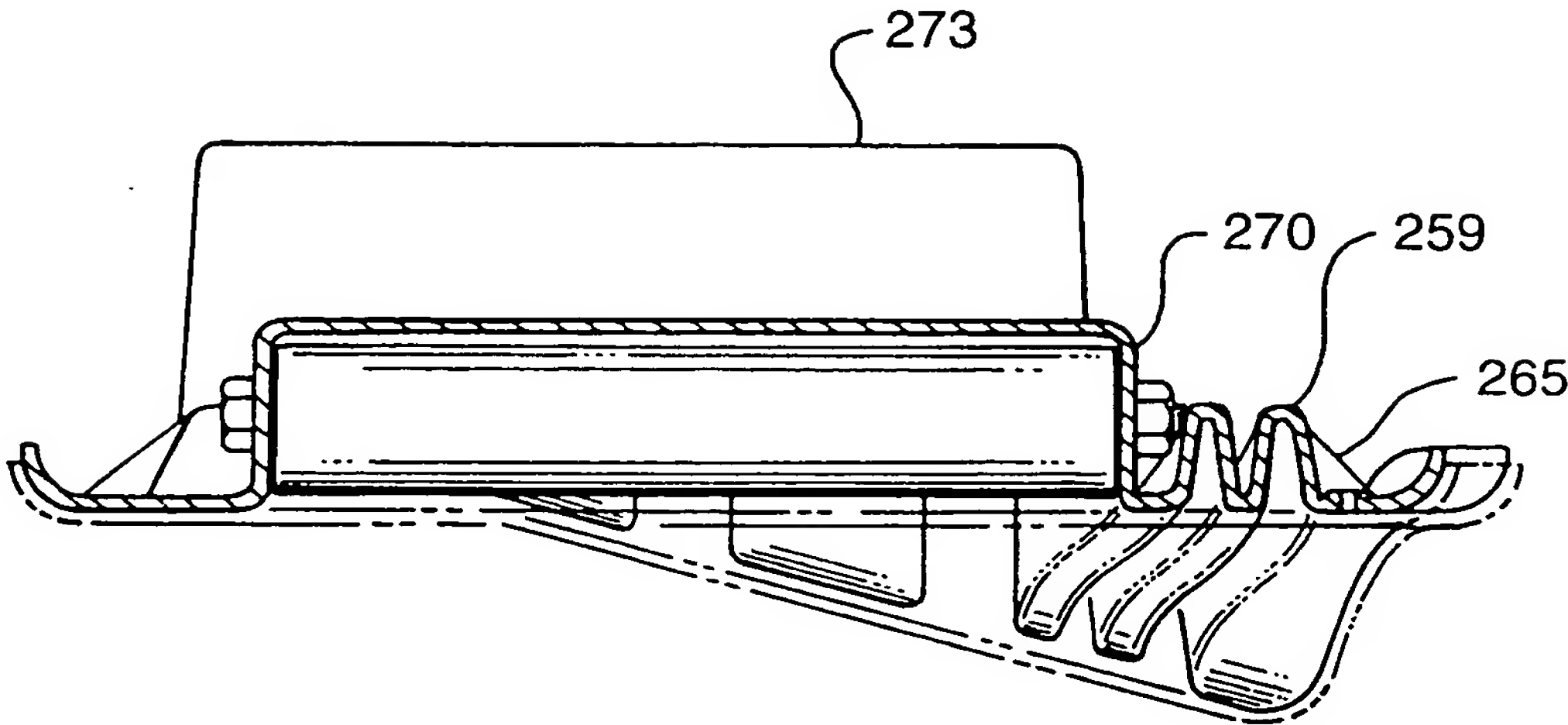


FIG. 16

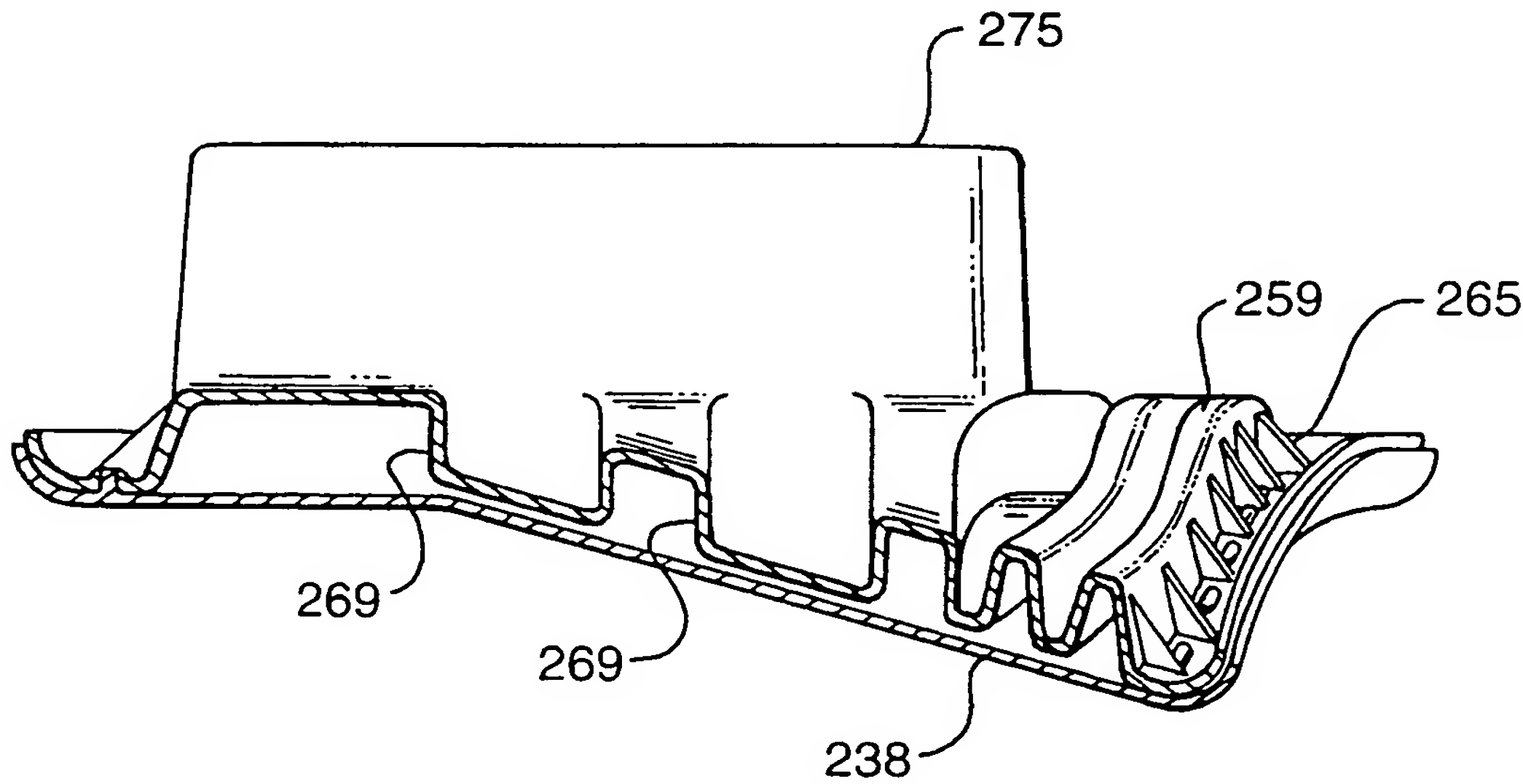


FIG. 17

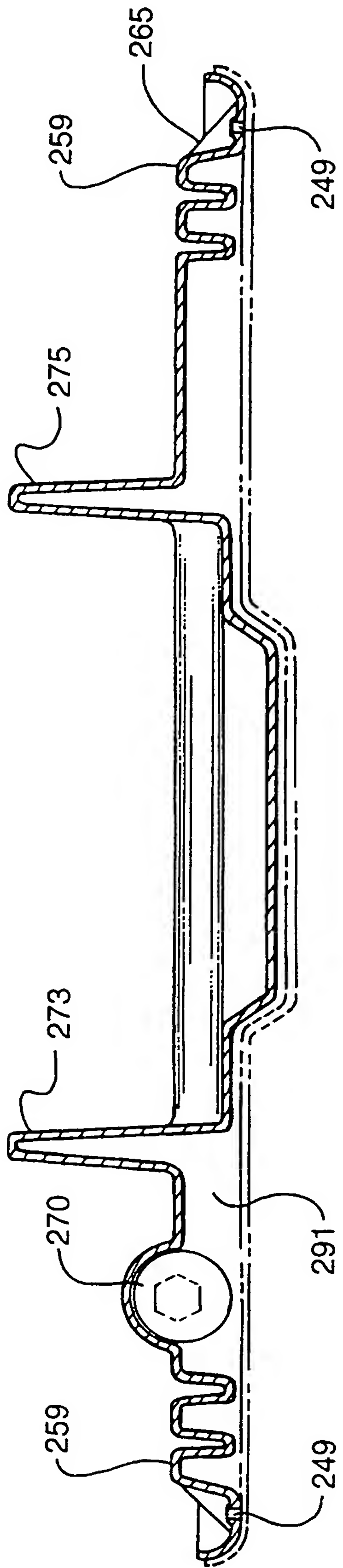


FIG. 18

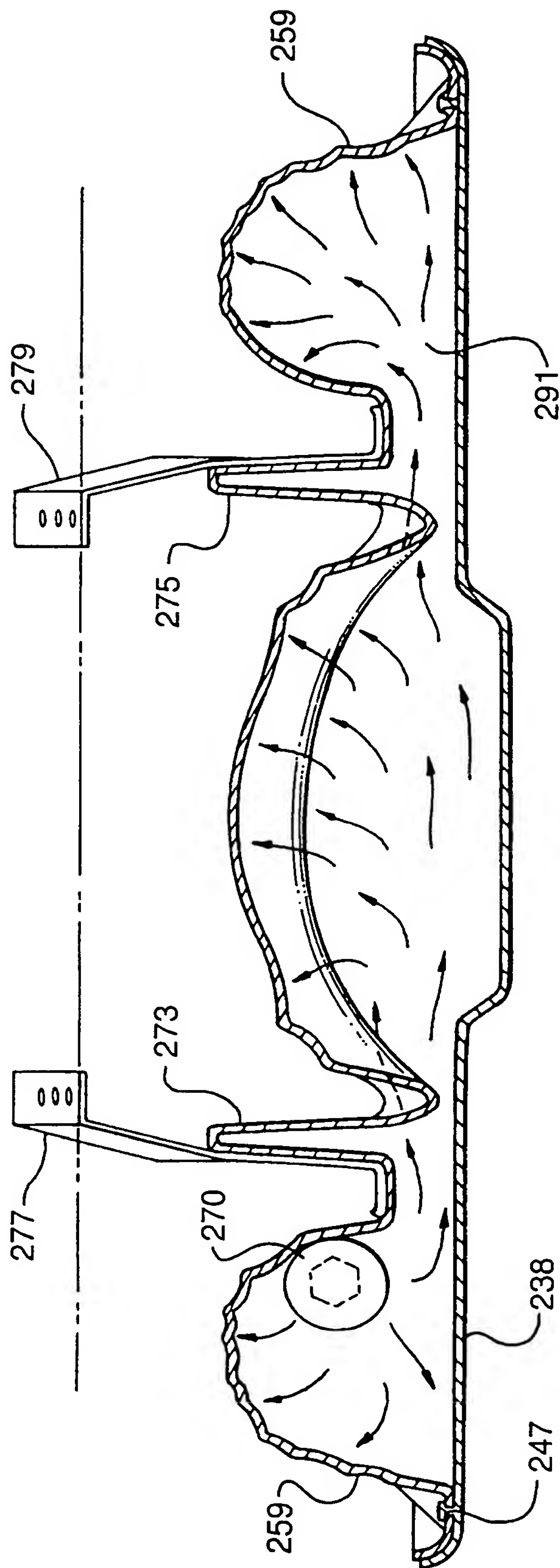


FIG. 19

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/00236

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60R21/045 B60R21/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 382 051 A (GLANCE PAUL C) 17 January 1995 (1995-01-17) column 3, line 62 -column 4, line 13 ---	1,15,20
P,X	WO 00 07851 A (ABC GROUP INTERIOR SYSTEMS A D ;DELPHI TECH INC (US)) 17 February 2000 (2000-02-17) the whole document	1,15,20
P,X	& US 6 032 978 A (SPENCER GRAHAM THORNTON ET AL) 7 March 2000 (2000-03-07) cited in the application the whole document ---	1,15,20
X	DE 39 34 588 A (AUDI NSU AUTO UNION AG) 25 April 1991 (1991-04-25) column 3, line 25 - line 48 ---	1,15,20
-/--		



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

12 April 2001

Date of mailing of the international search report

20/04/2001

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Fax (+31-70) 340-3016

Authorized officer

Standring, M

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/00236

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 615 914 A (ITALIANE JOHN R ET AL) 1 April 1997 (1997-04-01) column 3, line 25 - line 48 ---	1,15,20
A	EP 0 684 167 A (TRW REPA GMBH) 29 November 1995 (1995-11-29) the whole document -----	1,15,20

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. .nal Application No

PCT/US 01/00236

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5382051 A	17-01-1995	NONE	
WO 0007851 A	17-02-2000	US 6032978 A AU 5772099 A US 6203057 B	07-03-2000 28-02-2000 20-03-2001
DE 3934588 A	25-04-1991	NONE	
US 5615914 A	01-04-1997	AU 4647996 A EP 0801611 A JP 10512210 T US 5868422 A WO 9622199 A US 5752717 A	07-08-1996 22-10-1997 24-11-1998 09-02-1999 25-07-1996 19-05-1998
EP 0684167 A	29-11-1995	DE 4418628 A CN 1118750 A DE 59500522 D ES 2107271 T JP 2759065 B JP 8301054 A US 5570901 A	30-11-1995 20-03-1996 25-09-1997 16-11-1997 28-05-1998 19-11-1996 05-11-1996

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2005/000007

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B60R 21/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20020185847 A1 (KHOUDARI ET AL), 12 December 2002 (12.12.2002), paragraph [0022], [0025], fig 5 --	1-9
X	US 5382051 A (GLANCE), 17 January 1995 (17.01.1995), column 3, line 37 - line 61, abstract --	1-9
X	WO 0151317 A1 (DELPH TECHNOLOGIES, INC), 19 July 2001 (19.07.2001), page 5, line 21 - page 6, line 11, figure 5 --	1-9

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier application or patent but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

& document member of the same patent family

Date of the actual completion of the international search

20 April 2005

Date of mailing of the international search report

12 -05- 2005

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Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 2005/000007

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19801777 A1 (AMON, IRENE), 2 June 1999 (02.06.1999) --	1-9
A	US 5879767 A (MATSUSHIMA ET AL), 9 March 1999 (09.03.1999) --	1-9
A	US 5653464 A (BREED ET AL), 5 August 1997 (05.08.1997) -- -----	1-9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2005/000007

US	20020185847	A1	12/12/2002	US	6578867 B	17/06/2003
US	5382051	A	17/01/1995	NONE		
WO	0151317	A1	19/07/2001	US	6213497 B	10/04/2001
				US	6619689 B	16/09/2003
				US	6758493 B	06/07/2004
				US	20010054811 A	27/12/2001
				US	20020125691 A	12/09/2002
				US	20030006598 A	09/01/2003
DE	19801777	A1	02/06/1999	DE	29823323 U	26/08/1999
US	5879767	A	09/03/1999	DE	4142884 A,C	02/07/1992
				GB	2252983 A,B	26/08/1992
				GB	2282575 A,B	12/04/1995
				GB	9127276 D	00/00/0000
				GB	9410576 D	00/00/0000
				JP	4228648 A	18/08/1992
				US	5618595 A	08/04/1997
US	5653464	A	05/08/1997	JP	9240407 A	16/09/1997
				US	5746446 A	05/05/1998
				US	5863068 A	26/01/1999
				US	6149194 A	21/11/2000
				US	6250668 B	26/06/2001
				US	6715790 B	06/04/2004
				US	20010035634 A	01/11/2001
				US	20040256842 A	23/12/2004

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

Erik Meuller
Autoliv Development AB
447 83 VÅRGÅRDA
Sweden

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

12 -05- 2005

Applicant's or agent's file reference
SP 40000 WO

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/SE 2005/000007

International filing date (day/month/year)

07.01.2005

Priority date (day/month/year)

10.02.2004

International Patent Classification (IPC) or both national classification and IPC

B60R21/16

Applicant

Autoliv Development AB et al

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further opinions, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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Patent- och registreringsverket
Box 5055
S-102 42 STOCKHOLM

Facsimile No. +46 8 667 72 88

Authorized officer

Hans Nordström/EK

Telephone No. +46 8 782 25 00

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/SE 2005/000007

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language, _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ in written format

☐ in computer readable form

c. time of filing/furnishing

☐ contained in the international application as filed.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/SE 2005/000007

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	4, 5	YES
	Claims	1-3, 6-9	NO
Inventive step (IS)	Claims		YES
	Claims	1-9	NO
Industrial applicability (IA)	Claims	1-9	YES
	Claims		NO

2. Citations and explanations:

The object of the invention is to realize a method of making an air-bag and an air-bag which survive hostile condition and which can unfold on inflation.

Cited document:

D1: US 20020185847 A1

D1 is considered to represent the closest prior art. D1 reveals a method of making an air-bag. A selected plastics material is blow moulded to form the air-bag in a mould corresponding to the final uninflated state of the air-bag. The mould is such that the moulded air-bag has intended regions, which, on inflation of the air-bag, becomes outwardly extended. Consequently, the invention according to claim 1 is known and claim 1 lacks novelty.

The invention defined in claims 2, 3, 6-9 is also known from D1 and claims 2, 3, 6-9 lack novelty.

Claims 4 and 5 are considered to describe obvious matters of design and lack an inventive step.

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/SE 2005/000007

Box No. VII Certain defects in the international application

The following defects in the form or content of the international application have been noted:

The claims shall contain a characterizing portion (PCT-Rule 6.3(b)).



INVESTOR IN PEOPLE

Application No: GB0402898.1

Examiner: Monty Siddique

Claims searched: 1-12

Date of search: 29 April 2004

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular reference
X	1, 9 at least	✓ WO2004/009329 A1 (AUTOLIV DEV) mould construction does not prevent moulded article from assuming a depressed state
A	1	✓ DE4040591 A (CONTINENTAL AG)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^w :

B5A; B7B

Worldwide search of patent documents classified in the following areas of the IPC⁰⁷

B29C; B29D; B60R

The following online and other databases have been used in the preparation of this search report

WPI EPODOC JAPIO